

the mean pressure was more than .10 below the normal on the middle Pacific coast, over the middle and northern plateau regions, and on the northeast slope of the Rocky Mountains.

The monthly barometric ranges at regular stations of the Signal Service are shown in the table of Signal Service data on the last two pages of the REVIEW.

Tabulated statement showing principal characteristics of areas of high and low pressure.

| Barometer. | First observed. | | | Last observed. | | | Duration. | Velocity per hour. | Maximum pressure change and maximum abnormal temperature change in twelve hours and maximum wind velocity. | | | | | | | | | |
|--------------------|-----------------|---------|----------|----------------|----------|-----|-----------|--------------------|--|-------|-------|-------------------------|-------|-------|---------------------|------------|-----------------|-------|
| | Date. | Lat. N. | Long. W. | Lat. N. | Long. W. | | | | Station. | Rise. | Date. | Station. | Fall. | Date. | Station. | Direction. | Miles per hour. | Date. |
| High areas. | | | | | | | | | | | | | | | | | | |
| I..... | 1 | 54 | 112 | 58 | 73 | 4.0 | 32 | | Chatham, N. B. | .54 | 4 | Dodge City, Kans. | 34 | 2 | Wood's Holl, Mass. | nw. | 48 | 4 |
| II..... | 7 | 54 | 118 | 46 | 68 | 5.0 | 41 | | Fort Custer, Mont. | .66 | 7 | Omaha, Neb. | 35 | 8 | Fort McKinney, Wyo. | n. | 64 | 7 |
| III..... | 12 | 54 | 117 | 31 | 73 | 4.0 | 36 | | Helena, Mont. | .48 | 12 | Fort Assiniboine, Mont. | 24 | 12 | Kitty Hawk, N.C. | ne. | 64 | 15 |
| IV..... | 14 | 55 | 117 | 47 | 67 | 0.0 | 24 | | Eastport, Me. | .56 | 19 | Rapid City, S. Dak. | 40 | 15 | Chicago, Ill. | sw. | 46 | 18 |
| V..... | 20 | 55 | 120 | 42 | 65 | 4.5 | 30 | | Anticosti Island, G. S. L. | .78 | 23 | Fort Buford, N. Dak. | 28 | 20 | Kitty Hawk, N.C. | nw. | 52 | 22 |
| VI..... | 24 | 53 | 116 | 41 | 90 | 4.0 | 26 | | Yarmouth, N. S. | .76 | 27 | Kansas City, Mo. | 45 | 24 | Abilene, Tex. | n. | 52 | 25 |
| Mean..... | | | | | | 4.6 | 30 | | | .63 | | | 34 | | | | 54 | |
| Low areas. | | | | | | | | | | | | | | | | | | |
| I..... | 1 | 43 | 123 | 34 | 94 | 1.5 | 52 | | Chatham, N. B. | 1.00 | 3 | Sydney, C. B. I. | 39 | 3 | Winnemucca, Nev. | sw. | 46 | 1 |
| II..... | 2 | 44 | 86 | 48 | 57 | 1.5 | 44 | | Louisville, Ky. | .40 | 7 | Rockliffe, Ont. | 25 | 7 | Block Island, R. I. | sw. | 46 | 3 |
| III..... | 5 | 32 | 104 | 58 | 71 | 2.5 | 30 | | Yarmouth, N. S. | .92 | 10 | Columbus, Ohio. | 21 | 9 | Sioux City, Iowa. | ne. | 56 | 7 |
| IV..... | 8 | 40 | 90 | 49 | 66 | 2.5 | 36 | | Calgary, N. W. T. | .52 | 11 | Medicine Hat, N. W. T. | 25 | 11 | Montreal, Quebec. | e. | 48 | 10 |
| V..... | 11 | 55 | 127 | 46 | 108 | 1.0 | 40 | | Father Point, Quebec. | .72 | 16 | Albany, N. Y. | 31 | 15 | Fort Canby, Wash. | sw. | 56 | 12 |
| VI..... | 12 | 48 | 130 | 58 | 106 | 4.0 | 18 | | Chatham, N. B. | .54 | 21 | Louisville, Ky. | 32 | 20 | Winnemucca, Nev. | s. | 56 | 16 |
| VII..... | 14 | 47 | 111 | 50 | 55 | 2.5 | 48 | | Sault Ste. Marie, Mich. | .58 | 24 | La Crosse, Wis. | 30 | 23 | Block Island, R. I. | e. | 42 | 21 |
| VIII..... | 21 | 44 | 130 | 34 | 100 | 0.0 | 15 | | Eastport, Me. | .28 | 27 | Halifax, N. S. | 8 | 27 | Winnemucca, Nev. | sw. | 60 | 23 |
| IX..... | 24 | 43 | 93 | 59 | 65 | 2.0 | 33 | | Block Island, R. I. | .30 | 28 | Quebec, Quebec | 16 | 28 | Sydney, C. B. I. | sw. | 48 | 27 |
| Mean..... | 27 | 43 | 84 | 46 | 73 | 1.0 | 41 | | | .59 | | | 25 | | | | 56 | |

AREAS OF HIGH PRESSURE.

Six areas of high pressure were observed during the month, all of which reached the Atlantic coast within the limits of the United States. They were first observed in the region north of Montana or British Columbia, and the general direction of their movement was to the south over the Rocky Mountain regions, and thence eastward to the Atlantic, inclining slightly to the north of east after reaching the Mississippi Valley. Only two areas of high passed eastward north of the Lake region, and in each case secondary areas formed within the limits of the United States and united with the principal area while the latter was central over the Saint Lawrence Valley.

The following is a general description of each area of high pressure observed, based upon regular daily telegraphic reports:

I.—This area of high pressure had appeared in the extreme northwest in the latter part of January, and at the opening of the month it covered the Missouri Valley and the regions to the northward, the barometric pressure being greatest at Calgary, N. W. T., where it was 30.84, and the temperature -38° . At Battleford, N. W. T., the temperature was -44° , and at Qu' Appelle, N. W. T., -42° , the pressure being above 30.60. During the movement of this area to the southward it apparently separated, one portion passing to the west of the Rocky Mountains over Idaho, and the other passing eastward over Manitoba, this being the condition observed on the morning of the 2d; but by the morning of the 3d these areas had united, forming a well-defined area of high pressure central over Colorado, from which region it passed directly eastward, covering the entire country east of the Rocky Mountains during the 4th, and the Atlantic coast on the 5th, when it disappeared to the eastward. The cold wave attending this area of high pressure extended from the Lake region to the Gulf of Mexico, the fall in temperature exceeding 30° in twenty-four hours over large areas of the east Gulf and middle Atlantic states and the Ohio Valley. This cold wave was also severe over the Maritime Provinces, where the fall in temperature ranged from 20° to 34° in twenty-four hours on the 5th, and a temperature of -24° occurred at Chatham, N. B., on the morning of the 5th.

II.—Appeared over British Columbia on the 7th and passed eastward toward Manitoba during the 8th, on which date a secondary area formed over the northern plateau region. The

a. m. report of the 9th exhibited two areas of high pressure, one to the northeast of Manitoba, from which apparently a secondary had passed over the Saint Lawrence Valley, and a second area covering the greater portion of the Rocky Mountain regions, the pressure being greatest over Utah. The telegraphic reports received during the night showed a general drift of the mountain area of high pressure to the southeast. It covered the southwest on the morning of the 10th, having been preceded by a dry norther in Texas. After reaching Texas the direction of movement changed to the north of east, and it passed over the eastern portion of the United States during the 11th and 12th, attended by clearing and fair weather, but not unusually low temperature. It was last located as central on the 40th parallel near Martha's Vineyard, Mass.

III.—This area of high pressure was observed north of Montana on the 12th, while on the afternoon of the 11th a second area was forming over the southern plateau region. The high of the north had moved eastward rapidly north of the Lake region, while the southern area was apparently retarded and remained in the central Rocky Mountain region until the afternoon of the 13th, when it had reached the upper Mississippi valley. The following report indicated that these two areas had united north of the lower lake region, forming a barometric condition, the southern half of which covered the eastern half of the United States. After the union of these two areas of high pressure the direction of movement changed to the southward, and the area passed over the middle Atlantic states and off the south Atlantic coast, the barometric pressure decreasing with the southerly movement. On the morning of the 16th it was central near the 30th parallel on the meridian of Washington City.

IV.—Was first observed in Alberta on the morning of the 14th. It passed slowly southeastward over the Rocky Mountain regions, but during this movement it was not well defined and developed but slight energy. After reaching the northern boundary of Wyoming it passed rapidly to the southeast, attended by increasing pressure at the centre, and on the morning of the 18th it covered the country lying between the Alleghany and the Rocky Mountains, the centre being located in southern Iowa, where the northeasterly movement of this area commenced. This area passed over the Lake region on the 19th and over New England and the Maritime Provinces on

the 20th, the barometric pressure continuing to increase until the centre reached the coast line.

V.—Was observed in northeast British Columbia on the morning of the 20th, when areas of low pressure were observed in the upper Mississippi valley and on the north Pacific coast. This area passed eastward to Manitoba by the morning of the 22d, when the telegraphic reports showed an extension to the southward, a large volume of cold air having covered the eastern slope of the Rocky Mountains as far southward as Texas. The principal area of high pressure remained central over Manitoba, while the secondary had formed over the central valleys central near Cairo, Ill. These areas apparently moved eastward and united in northern New York on the morning of the 23d and disappeared to the east of New England during the 24th.

VI.—Appeared in the region north of Idaho on the 24th and remained almost stationary in that region until the 27th, when a southeasterly movement set in which carried the centre of this area to the lower Missouri valley by the morning of the 28th, and at the close of the month it had reached the upper Mississippi valley, apparently moving toward the Lake region.

AREAS OF LOW PRESSURE.

Nine areas of low pressure have been traced on the weather charts for February, and in addition to these, three secondary or short-lived disturbances were observed in the Rocky Mountain districts, the latter disappearing to the west of the Mississippi Valley, unattended by marked weather changes. Of the nine principal areas observed, five appeared first on the Pacific coast, four to the north of San Francisco, Cal., and one near San Diego, Cal. These disturbances were all traced to the east of the Rocky Mountains. Seven areas of low pressure passed eastward over the Mississippi Valley north of Cairo, Ill., the centre of disturbance generally reaching the Saint Lawrence Valley well to the north; one disturbance developed in the south Atlantic states and passed northeastward over Nova Scotia. The direction of movement was slightly to the north of east while the disturbances were passing over the territory to the east of the 100th meridian, the inclination to the north being greater in the areas of the lower latitudes. The direction of movement to the west of the Rocky Mountains was slightly to the south of east, with two exceptions, viz., low area No. III, which moved almost directly south from Montana, and No. VI, which moved directly northeast from California to Lake Superior.

The following is a description of the weather conditions observed during the transit of each area of low pressure:

❶ I.—This disturbance covered the north Pacific coast at the opening of the month, and on the afternoon of the 1st it was apparently central near Salt Lake City, Utah, attended by snows at the northern Rocky Mountain stations and in the Missouri Valley. It passed southeastward over Colorado, reaching northern Texas on the morning of the 2d, after which two depressions were formed in the trough of low pressure which bounded the east quadrants of the high area which then covered the Rocky Mountain regions. One of these low areas passed southeastward to the lower Mississippi valley, where it filled up, and the other developed considerable energy over the Lake region and passed northeastward, attended by severe gales, and rain changing to snow throughout the northern states east of the Mississippi river on the 3d. This storm continued to increase in force as it approached the coast, attaining its maximum energy while central over Maine on the afternoon of the 3d, when the barometer at Eastport was 29.08. Gales extended along the coast to Hatteras, N. C., on the 3d, and continued at northeast stations on the 4th. After passing to the northeast of New England the storm apparently increased in size, attended by general increase of pressure at the centre of disturbance.

❷ II.—Was observed in the upper Rio Grande valley on the 5th, and moved northeastward to the lower Ohio valley, where it was central on the morning of the 7th, reports showing a well-defined depression, attended by very heavy rains in the

Southern States and light rains as far north as the 40th parallel. The pressure decreased about .40 of an inch during the passage of this area from New Mexico to the Ohio Valley. The subsequent movement northeastward showed an increase of pressure at the centre of disturbance, and it apparently disappeared by increase of pressure after reaching the middle Atlantic coast.

III.—This storm developed in the region north of Montana, where it was first observed on the 5th, having been preceded in that region by a secondary disturbance which moved slowly eastward during the 3d and 4th and disappeared while central over Manitoba on the 5th. Low area No. III moved southward over the Rocky Mountain regions in advance of a cold wave, and after reaching northern Texas on the afternoon of the 7th three disturbances were formed in the barometric trough which bounded the southeast quadrant of the advancing high area. One of these secondary disturbances followed the Rio Grande Valley and disappeared over the west Gulf on the 9th; the second moved eastward over the west Gulf states and disappeared over the Mississippi Valley on the 9th; while the third developed in the lower Missouri valley and moved northeastward over the Lake region and the Saint Lawrence Valley during the 8th and 9th, disappearing to the east of the Maritime Provinces on the 10th. This disturbance was by far the most decided of the three, and it moved eastward with increasing energy, and did not attain its maximum force until reaching Nova Scotia. The pressure diminished during its easterly movement from 29.80 when it first developed in the Missouri Valley to 29.26 at Sydney, C. B. I.

IV and V.—These disturbances apparently developed over the north Pacific. The first was observed north of Washington on the 11th, and after moving southeastward to Montana during the succeeding twenty-four hours it filled up, owing to the advance of a more decided disturbance which appeared on the north Pacific coast on the 12th. Previous to the development of these storms on the Pacific coast two minor depressions were observed in the Rocky Mountain regions, one passing from the region north of Montana almost directly southward to Colorado, where it disappeared on the 11th. The other disturbance originated in the Rio Grande Valley and after moving eastward over Texas disappeared by increase of pressure in the lower Mississippi valley on the 12th. Low area No. V was central over the north Pacific some distance from the coast line on the afternoon of the 12th, when southerly gales were reported north of California. The disturbance apparently advanced to the southeast, covering the coast and plateau regions, while the centre remained to the northwest of Washington until the morning of the 14th, when a secondary developed over western Montana. This secondary moved eastward north of the Lake region, reaching Lake Superior on the 15th and the lower Saint Lawrence valley on the 16th. The original disturbance moved first southward to Nevada, attended by heavy rains in northern California. After reaching northern Nevada on the 15th it passed eastward over Utah and western Colorado, where it disappeared, but another secondary formed over eastern Kansas on the morning of the 16th and passed northeastward over the Lake region, attended by general rains east of the Mississippi and snow in the northern districts. This secondary covered the Lake region on the afternoon of the 17th, and was central in the lower Saint Lawrence valley on the morning of the 18th as a storm of marked energy, westerly gales being reported from the Lake region. The westerly gales extended eastward over the New England coast and the Maritime Provinces during the 18th, following the centre of disturbance which passed to the east of the coast line on that date.

VI.—Was first observed in southern California on the 18th. It moved slowly over the southern plateau region, reaching Colorado on the 19th, after which it moved rapidly to the northeast, reaching Lake Superior on the afternoon of the 20th, and finally disappearing to the north of the Saint Lawrence on the 22d. This storm was attended by general rains

in all districts, the rainfall amounting to almost an inch in southern California and Arizona. The rainfall was also heavy in the Mississippi Valley when the storm was central over Lake Superior.

VII.—Appeared on the Pacific coast on the 21st, attended by general rains on the coast and snow over the plateau regions. This storm continued during the 22d, the rainfall being very heavy, and the southerly gales unusually severe, causing considerable damage to shipping along the northern California and Oregon coasts. On the afternoon of the 22d the storm-centre had passed to the east of the coast line near southern Oregon, when the wind shifted to northerly, attended by snow over Washington as far west as the coast. This disturbance passed over the central plateau region to Colorado, where it was central on the afternoon of the 23d, when it included within its limits the entire region west of the Mississippi, the barometer being 29.20 near the centre. Rain continued on the Pacific coast and rain or snow in the Rocky Mountain regions and the Northwest. On the morning of the 24th a secondary disturbance formed over Iowa, while the principal low area remained central over Colorado. The secondary moved northeastward over the lakes with increasing energy, and was followed by a cold wave in the central valleys, which

separated the two depressions, the secondary moving eastward with decreasing pressure at the centre, while the primary remained stationary over Colorado, the pressure increasing at the centre with the advance of the area of high pressure until the 27th, when it moved southward to northern Texas, where it filled up.

VIII.—This storm developed in the southern extremity of the barometric trough which attended the preceding storm. It was first observed as central in northern Georgia on the 25th and moved northeastward, following the coast line, reaching North Carolina on the morning of the 26th and the south New England coast on the afternoon of that date. The westerly winds following this storm were severe over the Gulf and on the south Atlantic coast on the 26th. The storm apparently increased in force as it passed to the east of and along the New England coast during the 27th.

IX.—This disturbance formed in the upper lake region on the 27th and probably resulted as a secondary disturbance forming in the barometric trough which attended the disturbance described as No. VII. When the latter was central over northern Texas a slight depression existed over Michigan, which moved northeastward to the Saint Lawrence Valley, being central near Montreal, Quebec, at the close of the month.

NORTH ATLANTIC STORMS FOR FEBRUARY, 1891 (pressure in inches and millimetres; wind-force by Beaufort scale).

The paths of the storms that appeared over the west part of the north Atlantic Ocean during February, 1891, are shown on Chart I. These paths have been determined from international observations by captains of ocean steamships and sailing vessels received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Storms of marked severity were not reported on the north Atlantic Ocean during the month. Over and near the British Isles high barometric pressure continued during the first and second decades of the month, and after the 20th there were four dates, the 22d, 25th, 26th, and 28th, when the pressure fell below 30.00 (762) in Great Britain and Ireland. The high pressure over the eastern part of the ocean deflected the storms of western origin northward, and until the latter part of the month the centres passed north of the trans-Atlantic steamship routes before reaching the 25th meridian. Over the western part of the ocean storms of moderate strength advanced from the American continent at close intervals.

On the 1st a storm moved eastward over the Canadian Maritime Provinces and the Gulf of Saint Lawrence. On the 2d this storm was central on the northeast edge of the Banks of Newfoundland, with pressure below 29.30 (744) and fresh to strong gales, and by the 3d the storm-centre had advanced over mid-ocean north of the region of observation. On the 1st a storm of considerable strength, which had advanced from Newfoundland, was central over mid-ocean in high latitudes, after which it disappeared in the direction of Iceland. On the morning of the 4th a storm which had moved from the Saint Lawrence Valley was central over the northeast part of the Gulf of Saint Lawrence, with pressure below 29.30 (744), after which it passed northeastward beyond the region of observation. On the 6th a storm was central over mid-ocean in high latitudes. On the 7th and 8th a storm was central south and southeast of Nova Scotia, and by the 9th this storm had moved northeastward over the Banks of Newfoundland, with pressure about 29.40 (747) and fresh to strong gales, after which it moved northeastward and disappeared north of the region of observation after the 10th. On the morning of the 10th a storm was central over Maine, whence it moved northeast of Newfoundland by the 11th, with pressure below 29.20 (742) and fresh gales. By the 12th this storm had moved eastward to the 40th meridian, thence to about the 35th meridian by the 13th, and to the 30th meridian by the 14th, after which it

probably recurved westward and united with a storm which had advanced from south of Newfoundland.

On the 16th a storm moved eastward from the Saint Lawrence Valley over the Gulf of Saint Lawrence and on the morning of the 17th it was central northeast of the Grand Banks, whence it moved slowly eastward to about the 35th meridian by the 18th, after which it disappeared north of the region of observation. On the morning of the 17th a storm was central south of Nova Scotia, after which its course cannot be traced. On the morning of the 18th a storm of considerable strength, with pressure below 29.30 (744), was central in the Saint Lawrence Valley, and by the morning of the 19th this storm was central northeast of Newfoundland. Moving slowly eastward the storm-centre reached the 25th meridian by the 22d, after which it apparently recurved northward. During the night of the 18-19th a heavy snow storm prevailed at Saint John's, N. F. On the morning of the 19th the wind veered from south to northwest, blowing hard and driving to sea the ice which had closed the harbor for several days. This was the first storm of the month which advanced to the 25th meridian as far south as the trans-Atlantic steamship routes. On the 21st and 22d a storm moved eastward over the Saint Lawrence Valley and the Gulf of Saint Lawrence, and by the 23d had passed northeast of Newfoundland, with pressure below 29.20 (742). By the 24th the storm-centre had reached the 30th meridian, and on the 25th it was apparently southwest of Ireland, in which region its presence was indicated by reports of the 26th. This was the only storm of the month whose path can be traced over the ocean from coast to coast. On the 23d a northeast gale set in at Bermuda, with rain and high barometer, 30.30 (770). The storm continued until the 25th, with wind veering to east and southeast, and on the night of the 24th went to southwest, and on the 25th changed to west. Lowest barometer, 29.98 (761). On the morning of the 26th low pressure prevailed along the entire Atlantic coast of the United States and Canada, and on the morning of the 27th a storm of considerable strength, with pressure below 29.10 (739), was central over west Nova Scotia, whence it apparently moved rapidly northeastward and disappeared north of the region of observation by the 28th.

FOG IN FEBRUARY.

The limits of fog-belts west of the 40th meridian, as determined from reports of shipmasters, are shown on Chart I by dotted shading. East of the 55th meridian fog was reported